IGNITION OPERATIONS, S-234

UNIT 6 - PRESCRIBED FIRE SAFETY, PREVENTING ACCIDENTS AND DISASTERS

INSTRUCTIONS TO THE INSTRUCTOR

Handout 06-01-S234-HO needs to be given to the students the night before this lesson is to be presented. The students need to read it and have a good understanding of the case study Geraldton PB-3/79. The whole unit revolves around this case study. The slides for the case study need to be shown to the students after you have given the students the handout. When the instructor presents the unit the slides need to be looked at again.

This unit is best presented to the students through a general discussion format rather then in a lecture style format. Thus there is not a series of viewgraphs outlining the unit like other units within the course. It is important that over the course of discussion, all four objectives of this unit are covered. In leading the discussion of this unit, it is important that the students get involved.

Have the students close their student guide at this point. Make it known to the students that all the information that you are discussing is in the student guide for later reference. Having the student reading along in the student guide will stop the discussion process.

It works best, if as the instructor, you read through the Geraldton Case Study (06-01-S234-IR) several times prior to teaching the unit. This should allow a thorough understand of the events centering around this prescribed burn from Canada. The instructor outline should provide additional background into the Geraldton Case Study and assist in leading the discussion.

The unit starts with review of the difference between an accident and disaster. The basis of this unit then centers around Turner's Model ("The Development of Disasters - A Sequence Model for the Origin of Disasters", Social Review 24, 1976, 753-774) and the six stages to a disaster.

Handout 06-01-S234-HO and Instructor Reference 06-01-S234-IR are the same document.

DETAILED LESSON OUTLINE

COURSE: Ignition Operations, S-234

UNIT: 6 - Prescribed Fire Safety, Preventing Accidents and Disasters

SUGGESTED TIME: 1 1/2 hours

TRAINING AIDS: Overhead projector and screen, slide projector or computer with computer projector, screen and CD Rom; flip charts and markers, dry erase board and/or chalk board

OBJECTIVES:

1. Define the difference between the terms accident and disaster.

2. List six (6) recognizable stages of a prescribed fire disaster (Turner's Model).

3. Relate a prescribed fire case study to the developmental sequence of six stages associated with a disaster.

4. Describe adjustments that must be made to ensure the safety of prescribed fire operations.

OUTLINE	AIDS & CUES
PRESENT UNIT OBJECTIVES.	06-01-S234-VG 06-02-S234-VG
I. INTRODUCTION Too often we assume that serious, or even fatal, accidents are only the product of wildfire suppression actions. Experience, however, has sadly demonstrated a serious loss of life on prescribed burns as well. An investigative report on one event cited several contributing factors to the fatalities, including a preoccupation with target accomplishment, haste, over-	

confidence, span-of-control problems, and deviations from the approved plan.

The passage on target accomplishment is worth repeating:

"There has been a strong emphasis in recent years on the importance of prescribed burning in the forest regeneration and forest "health" programs. This has created a requirement to assign and meet targeted areas of prescribed burns. Undoubtedly the District staff, having been leaders in the prescribed burning program for over 10 years, feels this pressure keenly. These pressures were felt strongly and personally by the senior fire staff, who transmitted them to subordinate staff."

II. ACCIDENT VS. DISASTER

A. Accident

Unwanted events caused by individuals who do not adequately use shared beliefs to account for and cope with the hazardous situations they face.

In other words, an accident is simply a result of an individual's failure to conform to existing precautions.

The link between the failure and the result is short for an accident: no chaps = cut!

B. Disaster

An event, concentrated in time and space, which threatens people with major unwanted consequences as a result of the collapse of precautions which had been culturally accepted as adequate.
The most important feature of this definition is its treatment of disaster as a cultural event instead of a

OUTLINE (CONTINUATION)	AIDS & CUES

biological or physical event triggered by destructive agents.

The links are in and of themselves a series of failures which become accepted as the "norm" and accumulate slowly over time ultimately leading individuals or groups toward an unwanted and unexpected event: attitudes with regard to a specific behavior which don't allow us to see beyond our own confidence = an unexpected "bad" outcome.

For example: Let's think about this in the context of prescribed burning. There are units that regularly experience small "slop-overs" on burn projects. They may be viewed as something that "comes with the territory", the old "light 'em and fight em" mentality. On the west slopes of the Cascades it would not be uncommon to hear someone say "Don't worry it will go out when it hits the shade line". These attitudes allows us to become desensitized to the potential for extreme consequences.

C. Let's look at the six stages to a disaster: (Adapted to the prescribed fire situation from Turner's "The Development of Disasters - A Sequence Model for the Origin of Disasters", Sociological Review 24 (1976):753-774.

THE EMPHASIS SHOULD BE PLACED ON STAGE I AND II, HELPING THE STUDENTS TO RECOGNIZE HOW CULTURES ADAPT TO THE ATMOSPHERE OF ACCEPTANCE OF PREVIOUSLY UNACCEPTABLE BEHAVIORS. CHALLENGE THE STUDENTS TO RECOGNIZE THEIR LOCAL CULTURE.

OUTLINE (CONTINUATION)	AIDS & CUES
Stage I - Pre-disaster Starting Point: Initial culturally accepted beliefs about prescribed fire hazards. Associated precautionary rule set out in laws, guidelines, policies, etc. Stage II: Incubation period: the accumulation of an unnoticed set of events which are at odds with the accepted beliefs about prescribed fire hazards and the precautions to avoid these hazards. Stage III: Precipitation Undesirable Event: Undesirable prescribed fire situation which forces a re-direction of attention and transforms general perceptions of Stage II. Stage IV: Onset: The immediate consequences of the collapse of cultural precautions regarding prescribed fire become apparent. Stage V: Suppression, Rescue, and Salvage - First stage adjustment: The immediate post-collapse situation is recognized in ad-hoc adjustments which permit the work of fire suppression, rescue, and salvage to be started. Stage VI: Full cultural adjustment: An inquiry or assessment is carried out and beliefs and precautionary norms regarding prescribed fire are adjusted to fit the newly gained understanding of the character of prescribed fire hazards.	
INSTRUCTOR NEEDS TO BECOME FAMILIAR WITH THIS CASE STUDY. INSTRUCTOR NEEDS TO SHOW THE SLIDES AND POINT OUT WHERE PEOPLE ARE AND WHAT HAPPENED. THIS NEEDS TO BE DONE THE DAY BEFORE THIS UNIT IS TO BE PRESENTED.	06-01-S234-SL Thru 06-05-S234-SL 06-01-S234-IR 06-01-S234-HO
III. GERALDTON PB-3/79 CASE STUDY	

Was this case study and accident or disaster?

Was this tragic event simply the result of people not following established beliefs, guidelines, practices and policies related to prescribed fire?
Or was there a subtle accumulation of unnoticed events which were at odds with accepted beliefs about prescribed fire hazards and the precautions taken to avoid these hazards? The answer may well be yes to both questions.

IV. Geraldton PB-3/79 and Turner's Six Stages

Let's take a closer look to see how well the Geraldton Case Study fits Turner's model with respect to stage I? What was the culture on the Geraldton District?

A. Stage I - Pre-disaster Starting Point — 06-03-S234-VG

The disaster sequence commences with a set of culturally held beliefs about prescribed fire hazards. The beliefs constitute the "normal" stock of knowledge which is thought to provide the environment in which individuals and groups can survive successfully in a hazardous situation.

These normal beliefs are fundamental to the concept of an accident caused by an individual. We would then simply look for a violation of laws, policies or guidelines to provide an explanation for the injury. Once fault is found we need look no further. This concept is in and of itself the culture.

It's the common understanding that "We" understand the hazards and have the necessary precautions in place to abate those hazards. "We know what were doing, we've done it before, and we do it right". (Culture)

The Geraldton District in Ontario Canada had used prescribed fire as a part of their resource management program since the late 1950's.

Knowing that they had been developing a prescribed fire program for approximately 20 years we can make some assumptions that would allow us to agree that a culture with regard to prescribed fire had been established.

1. The fact is that there was a set of accepted beliefs, guidelines, and policies about prescribed fire hazards in Ontario.

    - Forest managers were committed to an increasing the prescribed fire program.

    - The program was taking advantage of advances in training and technology.

    - Apparently burn plans were a matter of policy and included a burning prescription (which was tested using computer programs), firing patterns, and an organization. In addition, test fires were used as a normal procedure.

2. Let's take a closer look to see if we can get some insight into the culture that existed prior to the Geraldton Incident.
   Key indicators may be:

    - The apparent use of a test fire as a formality, rather than a true evaluation of expected fire behavior.

OUTLINE (CONTINUATION)	AIDS & CUES
• The seemingly informal and ineffective briefing/communication that occurred prior to ignition. • Finally, the numerous deviations from the approved plan. As contributing factors to the final outcome, were these actions and attitudes confined only to this project? **STUDENTS NEED TO UNDERSTAND THAT THESE ATTITUDES ARE NOT UNCOMMON IN MANY OF TODAY'S PRESCRIBED FIRE PROGRAMS. STUDENTS SHOULD TAKE TIME TO REFLECT ON THEIR LOCAL CULTURES AND BE PREPARED TO DISCUSS THEM**.	
B. Stage II - Incubation Period	06-04-S234-VG
1. A prescribed fire disaster or cultural collapse occurs because of some inaccuracy or inadequacy in the accepted norms or beliefs. If the disruption is to be of any consequence the discrepancy between the perceptions of prescribed fire hazards and the way prescribed fire hazards really operate will not generally happen instantaneously. Instead, there is an accumulation, over a period of time, of a number of events which are at odds with the way things really are and the hazards represented by the norms and beliefs. Within this "incubation period" events occur and accumulate unnoticed or it may be that they were not communicated.	

Existing cultural precautions may be thought of as dealing with known and clearly defined hazards, but during the incubation period vague and unperceived hazards begin to be covertly delineated.

2. In order for events to build up in this way it is clear that they must fall into one of two categories: either they are not known to anyone; or they are known but not fully understood.

3. This incubation period may also be referred to as the "getting away with it" period which becomes culturally acceptable. This is a slow process where small incremental steps go unnoticed. There are five basic reasons for this to occur:

   - People are generally reluctant to fear the worst, with the result that they dismiss evidence of hazardous conditions and fail to notice warning signs of accumulating danger. How often do you share "near misses" during post-burn evaluations? Do they become the impetus for course correction or do they just become war stories?
   - Violations of prescribed fire policies and rules may become accepted as normal when people obtain misinformation or fail to learn appropriate beliefs and norms.
   - Information overload in complex situations may be so much of a

problem that people fail to see signs of danger.

This is a “head down” situation, when folks become preoccupied with details and fail to step back and see the overall situation.

- People’s attention may be directed from warning signs by one problem that acts as a decoy to draw attention away from another more serious problem.

  These decoys can take many forms. They may be personal or professional and they may also be imposed by other individuals.

- Prescribed fire which may escape at rather frequent intervals tend to elicit the development of institutions suited to routine accidents rather than disasters.

  We dismiss the escapes in the name of production, lack of funds, or lack of more skilled people, until at some point the escapes become culturally acceptable.

4. What we’ve been talking about are the ways in which events or the links accumulate. Remember the links to a disaster are like a slow motion wave, which when it finally crests, is overwhelming.

   There may well have been an accumulation of events from the late 1950's to 1979 that detracted from implementing normal

prescribed fire precautions on the Geraldton District.

If we look at some of the details we may gain better insight to the development of the incubation period and the events that might gradually have accumulated to affect Geraldton's prescribed fire program in a detrimental manner.

5. The approved plan was not entirely duplicated in the actual preparations for the burn. This is apparent in a number of ways and is attributable to a number of factors.

   a. Target Accomplishment: There was a strong province-wide emphasis on the importance of prescribed burning. This created a requirement to assign and meet targeted areas of prescribed burns.

      Undoubtedly, the Geraldton District staff, having been leaders in the prescribed burn program for over 10 years felt this pressure keenly.

      In the case of the PB3 burn, there was the added element of "time running out". With the probability of very few satisfactory burning opportunities left in the fire season and the certainty that most fire control staff would be lost within two weeks, the District was in a "now or never" situation.

These pressures were felt strongly and personally by the senior staff, who transmitted them to subordinate staff.

b. Haste: The pressures referred to in the previous discussion coupled with the "time running out" problem, and the probability that an acceptable burn might be achieved immediately, inevitably led to haste.

The burn was ignited less than 24 hours after Bateman and Hilliard checked slash fuel conditions. Many evidences of haste, were exhibited:

- Examination of fuels at Fire 13 instead of at PB-3 to determine suitability for burn.
- Fuel volumes not computed, although sample plots were in place and the data had been collected.
- Hasty organization of staff (e.g., Reynolds did not know his assignment until Wednesday morning).
- Key people not included in the briefing (e.g., members of Reynolds's ignition crew).
- No detailed on-site briefing of the ignition crew.
- Not all staff briefed on safety measures and instructions were vague.

- Very little time spent on the test fire.
- Equipment was incomplete (e.g., no funnel to fill torches, no relative humidity tables, torches at the burn without fuel, etc.).
- Ignition started without waiting for all of the staff to reach the staging area.

c. Over Confidence: From the start and for a number of reasons, everyone involved thought that PB-3 would be easy to manage and would pose no problems except perhaps that the fire intensity would be too low.

As already pointed out, the Geraldton District had been an active participant in a prescribed burn program. The staff developed expertise through the process of planning and conducting many prescribed burn projects. It is understandable that there would be little concern about their ability to manage PB-3.
Reinforcing the district's confidence was the fact that this was a simple, safe burning opportunity which even under sever conditions would offer no fire problems.

Furthermore, burning conditions were not severe and the forecast indicated rain no later than the evening of the day of the burn.

The final factor contributing to the lack of concern was the test fire set minutes before the ignition of the unit. Its initial slow rate of spread indicated that to the observers that the only problem they would have would be getting the main fire to burn.

d. Span of Control: It is obvious in hindsight that there were span-of - control problems with ignition. In fact, Reynolds recognized the problem on Block C and drew it to Hilliard's attention before leaving the base camp. Some evidence of the span-of-control problems are:

- There was not a completely clear picture of ignition sequences and details.
- Reynolds, Hilliard, and Bateman all gave some instruction about ignition. In itself, this is not necessarily bad, but it is an indication of the lack of "central" ignition control.
- The large number of ignitions made control difficult.

e. Deviations from Plans: Deviations of varying magnitudes were made from the original plan and from plans developed during the organizational stages. Most of the changes were reasonable, but rationale for others is questionable.

f. Inadequate staffing levels: Although the approved plan does not attach names to positions, the District policy would have indicated Shepherds as Fire Boss and Johnson as Trainee Fire Boss. With Shepherds on vacation and Johnson on a day-off and unable to be located, Hilliard and Reynolds were logical alternate choices. Bateman might have assumed the Fire Boss role if his knowledge of the burn area and plan had not been so limited.

The approved plan indicated a Safety Officer reporting to the Fire Boss, but this position was left vacant for reasons unknown.

g. Inadequate support staff: The most significant deviation was the number of ignition/suppression support staff assigned to the burn.

A detailed comparison of the original plan and the final real situation can be made elsewhere in the report, but in general terms, there were more than twice as many people on the burn as planned.
On Block C alone, there were 22 people compared with the maximum of seven implied in the plan.

The most serious product of this change was the assignment of seven inexperienced people to Dalton.

h. Equipment: Aerial ignition had originally been planned as a possibility for all or part of the burn, with

alternate ignition methods to be used if a helicopter was not available. The fact that hand ignition was employed was, therefore, not a deviation from the plan.

6. The Board of Review also presented serious reservations about another commonly accepted precaution that being the heavy reliance on the spot test fire as a last-minute guide to expected fire behavior.

   This point is worth discussing further, since the use of spot test fires is still a common practice. Some food for thought meant to provide a caution about their use.

   - A single spot ignition has a tight convex fire front, which may be quite different from the specific firing pattern being used. This aspect should be evaluated because you may not be replicating actual conditions and a spot ignition may produce much lower rates of spread and fire intensity than a strip head fire.

   - Even under strong wind, a spot test fire may elongate downwind and fail to develop the faster moving wide front perpendicular to the wind that is commonly seen with various firing patterns.

   - Any given spot may not be representative of average burning conditions in terms of slope, fuel load and continuity, or exposure to wind.

- Finally, the test fire, in a sense, negates the formal process of estimating spread rates well in advance from the combination of fire danger indices and previous burning experience.

  It is probable that more than 10 minutes would have been required for the test fire at PB-3 to develop its equilibrium fire spread, and even then nothing like the fire behavior of the real fire would have resulted.

  A test fire, to be a fair indication of potential fire behavior, would have to simulate reasonably well the actual ignition pattern employed.

C. Stage III - Precipitating Event — 06-05-S234-VG

1. The shock of a precipitating event is necessary to re-direct attention to the accumulation of unnoticed errors in the incubation period. The power of the precipitating event to transform beliefs and precautionary rules regarding prescribed fire is dependent upon total surprise.

   Although there may be a few “soothsayers” that predicted the event, general recognition of the underlying process which gave rise to

OUTLINE (CONTINUATION)	AIDS & CUES
significant fire losses will not occur unless it is unexpected.	
2. A transformation of culturally accepted prescribed fire beliefs and policies will occur only if a disastrous event is totally unpredictable.	
As previously discussed the expectation on PB-3 burn was that fire intensity and rates of spread would be low within the narrow window of opportunity. The occurrence of high intensity fire behavior was not predicted.	
D. Stage IV - Onset	06-06-S234-VG
1. The outbreak of a disastrous prescribed fire is followed immediately by the onset of unanticipated consequences which force practitioners to face realities not accounted for by existing prescribed fire measures.	
The onset of the prescribed fire disaster is represented by high intensity burning, rapid rates of spread, large area burned, and lives and property lost.	
2. How many times have you done a prescribed burn where all of the environmental parameters were aligned on the high side and gotten away with it?	
While most of the indices were well within the prescription parameters, there were seven fatalities and one serious injury on PB-3, which signaled the collapse of their cultural precautions.	
E. Stage V - Suppression, Rescue, and Salvage	06-07-S234-VG

OUTLINE (CONTINUATION)	AIDS & CUES
The onset of a disastrous prescribed fire is accompanied or followed by suppression, rescue, and salvage operations. Major features of a failure in existing beliefs and precautions become evident as people go about meeting immediate problems of suppression, rescue, and mop-up. On the PB-3 burn immediate post-collapse adjustments were made in terms fire control and mop-up, in order to facilitate rescue and ultimately the recovery of those who perished in the fire.	
F. Stage VI - Full Cultural Readjustment	06-08-S234-VG
After an agency has recovered from the immediate impacts of the onset of a disastrous prescribed fire, an assessment may be conducted to determine why culturally accepted precautions proved to be inadequate. Readjustments can only take place if the investigation reveals major failure of the existing beliefs and precautions. Following the Geraldton Incident an inquiry was conducted by a Board of Review and precautionary norms regarding prescribed fire were adjusted to fit a newly gained understanding. The Board of Review listed 21 recommendations following their analysis of the PB-3 burn. These recommendations were the foundation for their cultural readjustment.	06-01-S234-HO 06-01-S234-IR
V. Recognizing Your Local Culture	
Now that we have an understanding of Turner's model as it applies to the Geraldton Incident let's apply the concepts of Stage I and Stage II to our own local environment.	

- It is important to understand where we are culturally and whether any of our standard operating procedures or adaptations that we carry out constitute an incubation period.

HAVE THE CLASS COME UP WITH SOME EXAMPLES FROM THEIR HOME UNITS.

VI. SUMMARY

Prescribed fire activities are increasing in frequency and complexity for most resource management agencies. These prescribed fire programs also have included cases of serious loss of lives and property since 1979.

Although often taken for granted, prescribed fires offer some of the most potentially hazardous situations that we undertake. The very continuance of such programs is closely dependent on the care and skill we bring to this task. So that we don't become trapped, or surprised, by the unexpected, we have contrasted the terms "accident" and "disaster" and listed the six stages associated with a prescribed fire disaster.

A case study was employed to illustrate these six stages and to call attention to the accumulation of an unnoticed set of detrimental events during the incubation stage. Finally, we described and discussed adjustments that must be made to ensure the safety during prescribed fire operations.

The message is clear, we must always maintain a healthy respect for fire, apply the fundamentals that we know so well to prevent accidents, and be alert toward changing conditions to prevent disasters.

REVIEW UNIT OBJECTIVES.

IGNITION OPERATIONS, S234

UNIT 6 - PRESCRIBED FIRE SAFETY, PREVENTING ACCIDENTS AND DISASTERS

VIEWGRAPH INDEX

Reference #	Description
06-01-S234-VG	Unit objectives
06-02-S234-VG	Unit objectives
06-03-S234-VG	Stage 1 Pre-disaster Starting Point
06-04-S234-VG	Stage 2 Incubation Period
06-05-S234-VG	Stage 3 Precipitation Undesirable Event
06-06-S234-VG	Stage 4 Onset
06-07-S234-VG	Stage 5 Suppression, Rescue, and Salvage
06-08-S234-VG	Stage 6 Full Cultural Adjustment

IGNITION OPERATIONS, S234

UNIT 6—PRESCRIBED FIRE SAFETY, PREVENTING ACCIDENTS AND DISASTERS

HANDOUT INDEX

Reference #	Description
06-01-S234-HO	CASE STUDY: GERALDTON PB-3/79

IGNITION OPERATIONS, S234

UNIT 6 - PRESCRIBED FIRE SAFETY, PREVENTING ACCIDENTS AND DISASTERS

SLIDE INDEX

Reference #	Description
06-01-S234-SL	Geraldton PB-3/79 prescribed burn unit layout.
06-02-S234-SL	Geraldton PB-3/79 prescribed burn unit layout, two minutes after slide number one.
06-03-S234-SL	Geraldton PB-3/79 prescribed burn unit layout, one minute after slide number two.
06-04-S234-SL	Geraldton PB-3/79 prescribed burn unit layout, one minute after slide number three.
06-05-S234-SL	Geraldton PB-3/79 prescribed burn unit layout, three minutes after slide number four. Note the young people died at point b, circled in yellow and Dalton ran through the fire and is at point W.

IGNITION OPERATIONS, S234

UNIT 6 - PRESCRIBED FIRE SAFETY, PREVENTING ACCIDENTS AND DISASTERS

INSTRUCTOR REFERENCE INDEX

Reference #	Description
06-01-S234-IR	CASE STUDY: GERALDTON PB-3/79

BACKGROUND

The use of prescribed fire in Ontario, Canada, has been a part of the normal resource management program since the late 1950's. The program has been regarded as an effective and relatively inexpensive method of accomplishing forest and wildlife objectives. The Forest Management Program increased its targets substantially in response to a need for more forest regeneration. Increasing costs of mechanical site preparation have placed more emphasis on prescribed burning as an alternative site preparation method. The Forest Management and Fire Control organizations have committed to an expanding program. Advances in training, technology, and methods applied to prescribed burning along with staff interest and commitment accounts for the increase in prescribed burn outputs.

The PB-3 burn was divided into three separate blocks. Block A was 25 hectares, Block B was 35 hectares, and Block C was 60 hectares. Main tree species on the area were balsam fir, white spruce, and black spruce, with a small amount of white birch. The purpose of the burn was to prepare the site for hand planting. The area was clear-cut in 1979 with some thickets of balsam fir left as residual stands. The topography was flat to rolling.

The area to be burned was selected in the fall of 1978. This gave District Staff enough time to visit the site several times during the planning period to examine fuel and topographic conditions, and to prepare the plan prior to the 1979 operating season. Only part of Block C had been cut at that time. Several visits made during the winter resulted in some modifications to the plan which were intended to enhance the burning operation.

There was good cooperation in the plan development. The silviculture prescription was prepared with consultation between Forest Management and Fire Control staff. The prescription would achieve the results required to prepare the area for regeneration.

The data from the fuel sampling plots established by Forest Management and Fire Control staff were not compiled prior to the burn. The fuel loading appears to have been an important factor affecting fire behavior in this case.

The fire prescription was developed from the Canadian Forest Fire Danger Rating System (CFFDRS). The selected prescription was tested with two computer programs designed for the purpose. One, called PBWX, is based on historical fire weather information that is used to predict an expected number of days a

particular range of fire prescriptions should occur. The second part, called PBPJ, used the Fire Behavior Index tables from Supplement ONT-I of the CFFDRS to predict fire behavior for given codes and indices.

The test indicated that predicted fire behavior would be manageable with an intense, rapidly spreading fire expected at the maximum prescription.

Table 1 compares the codes and indices prescribed with those actually experienced on the day of the burn (August 22, 1979). Most actual values are somewhat lower than the prescribed values. The actual values are adequate to permit slash burning. The planned prescription is acceptable.

Table 1
Comparison of Codes and Indices - Wawong Lake Fire Base

Code	Prescribed	Actual Aug. 22/79
Fire Fuel Moisture Code (FFMC)	87 - 92	84
Duff Moisture Code (DMC)	30 - 50	16
Drought Code (DC)	100 - 150	295
Build Up Index (BUI)	28 - 48	27
Initial Spread Index (ISI)	5 - 8	3
Fire Weather Index (FWI)	10 - 20	6
Relative Humidity (RH%)	0 - 50	62
Windspeed(km/hr	0 - 7	9
Direction	SE - S/SW	South

IGNITION TACTICS

In order to clearly understand the ignition sequences on PB-3, it is important to keep in mind the feelings of key personnel with respect to burning conditions. Forecasted poor weather and moderate CFFDRS codes and indices were key factors explaining the choice of ignition pattern, which was actually somewhat different from either of the two specified in the approved plan. To the senior staff, all indications were that difficulty in obtaining adequate fire behavior would be encountered.

Perhaps the single most crucial question in this entire investigation is why Dalton and the young people with him were on the inside of what eventually became a ring of fire instead of on the outside. The answer must lie in the basic misunderstanding as to the ignition pattern and its execution between Dalton on one hand and Hilliard and Reynolds on the other.

Hilliard and Reynolds (positions A & B) had decided on a U-shaped ignition pattern open downwind to the north. This would be well suited to the situation of Block C, with an essentially non-combustible area to the east, west, and north. There was thus no danger of downwind fire escape, and no reason to secure the downwind side. The U-shaped pattern would be, in effect, midway between a conventional strip pattern and a complete circular or convection style ignition (both were specified as choices in the approved plan). It would tend to burn out the area enclosed more effectively than a straight line of fire, an especially desirable consideration on a day when, as most people thought, burning would be slow and difficult. This pattern could furthermore be repeated as often as necessary at intervals progressively upwind.

Dalton, (positions 3 on slides one through four and W on slide five) although directed in some manner to the northeast side of the hill, had incomplete knowledge of where other people would be igniting. He apparently pictured, not a multiple "U" shaped ignition, but rather a series of strips progressively backward into the wind, of which his ignition along the northeast green edge would be the first. Once it was completed, he and the others would simply back up into the slash and repeat the process. It was thus understandable for him to light a line of fire between himself (along with the young people) and the green timber edge, never imagining that he should have been on the other side of it. Furthermore, smoke was drifting (at first) into the swamp rather than into the clear-cut. It would simply not have made sense to ignite from the smoky side rather than the clear side. Meanwhile, Reynolds thought that Dalton and his group would ignite as they proceeded, turning off to the east once they reached the green timber. They would then have been safely out of the way when the south side of the "U" was ignited.

While Dalton and the young people ignited downwind, others were directed to ignite at positions 1, 2, 4, and 5 at approximately the same time. Dalton and the young people were firing not knowing their escape routes had been cut off by the other firing operations. The bodies of the young people were found at position b.

One obvious principle in prescribed burning operations is that no ignition takes place anywhere upwind of anyone operating within a danger zone downwind. Certainly no south side ignitions would have taken place had anyone realized that Dalton and the young people were within the "U". It was thus the initial communication process that failed. Although the ignition plan was strategically sound everyone did not understand his role nor, more particularly, the role of others in the ignition process

Another logical safety principle is that any ignition line not basically across the wind should be lit proceeding upwind rather than downwind. This principle was broken twice at PB-3. Ignition was lit without serious consequences downwind, but the second instance contributed to the final tragedy. Had Dalton and the young people proceeded first to the far end of their eventual ignition line, then ignited on the way back, they could have moved out of harm's way as they approached the southeast corner. That they actually ignited while proceeding north (with the wind) was the result of the basic misunderstanding referred to earlier.

Also of significance is the fact that there were 14 people immediately involved in lighting fire in the initial ignition sequence in Block C, all in a confined area of 2.5 hectares. This alone would present management and communications problems, as well as establishing a large amount of fire in a very short time. More specifically, the eight persons involved in ignition on one small portion of the fire (northeast side) would be difficult to supervise.

In summary, it is apparent that a "U" shaped ignition pattern could have been established quite safely at PB-3 by sending two parties to the downwind ends, each of whom would return igniting from the outside along their respective arms of the "U" until they met at the upwind center near the staging area. As it turned out in the actual operations, the safety principles were violated in the following ways:

1. Ignition 1 was set while proceeding downwind rather than upwind.

2. The south side ignitions were lit before Dalton and his group were known to be out of the downwind zone.

3. Ignition 3 (Dalton's) was set while proceeding downwind rather than upwind, and from the inside of the "U" rather than the outside. The crucial misunderstanding behind this has been described.

4. The beginnings of a second pattern (ignitions 7 and 8) were begun before all parties involved in the first were accounted for.

The key ignitions took approximately 4 minutes, a time so compressed that Reynolds and Hilliard had no time to react to trouble, and nothing could be done to avoid the accident that happened 4 or 5 minutes later. By the time cries were heard at about 1219, it was too late, and any number of suppression crews on site could not have prevented the final result.

ENTRAPMENT

Just after noon on Wednesday, August 22, 1979, seven young people lost their lives 7 minutes after ignition within a prescribed fire known as Geraldton Prescribed Burn No. 3 (PB-3). The detailed movements of the seven young people can, of course, never be known. It is only certain that they did eventually come together in a balsam thicket where they were finally found. The key point is that Dalton and the entire group were igniting fire between themselves and the green timber. It is reasonable to suppose that as Dalton ignited northwesterly along the green timber edge, the young people remained behind him, helping with the ignition (all had matches) as they went. Once Dalton sensed trouble, he shouted to the young people to follow him. The whole group may perhaps have converged uphill somewhere north of a balsam thicket, attempted under Dalton's urging to follow him, but were unable or unwilling to face the radiational heat from the north and the prospect of plunging through fire. They would then have been forced south into the balsam thicket seeking shelter, to be caught soon afterwards by the fires from the south and west. Meanwhile, Dalton, finding himself alone, forced his way through the only possible escape route at the last possible moment.

Recommendations

The Board of Review listed the following recommendations after their analysis of the PB-3 situation:

1. Prescribed burning continue as an important part of the site preparation program in Ontario in general and in the Geraldton District in particular.

2. A comprehensive Prescribed Burn Manual be compiled using the best and most current information available and that a target date of February 15, 1980, be established for completion of the prototype manual.

3. Concurrent with the compilation of a manual, a prescribed burn training program be developed with the objectives of having a course ready for presentation by April 1, 1980.

4. Staff in charge of prescribed burning operations be trained specifically in all available means of predicting the behavior of prescribed fires in various slash fuel types.

5. A formal step-by-step system be developed for predicting fire behavior in slash, incorporating the major pertinent factors such as species, fuel quantity, slope, and ignition pattern.

6. The use of test fires be discontinued as a means of judging the behavior of prescribed fires, and that the ignition sequence itself must be designed so that plans can be modified as a result of the behavior of the first ignitions.

7. As a part of a thorough on-site briefing, just prior to ignition of prescribed burns, ignition personnel be informed not only of their own responsibilities, but also of the proposed actions of other ignition crews in the overall ignition sequence.

8. The number of persons per ignition crew be kept to a maximum of a crew boss plus three ignitors.

9. As a general principle, no ignitions should take place upwind of persons operating downwind, and all ignition lines should be established while moving into or across the wind.

10. Ignition crews must be familiar with the prescribed burn site, escape routes, and safety zones.

11. The Ministry expand its program for developing ground and aerial ignition devices in order to minimize the number of personnel involved in ignition.

12. As many preparations as possible be made at early stages in the planning process (e.g., establishment of control lines, pre-selection of primary and alternate participants, and preburn site inspection by all potential participants).

13. However, short the preparation time available, all essential details should be considered before ignition, even if the opportunity to burn is lost. Further, to ensure the consideration of all details, a mandatory checklist should be developed and included in the Prescribed Burn Manual.

14. The Ignition Boss has guaranteed voice contact (radio) with the person responsible for each segment of the ignition so that he can direct the ignition timing, monitor ignition progress, order modifications, or give emergency instructions as required.

15. All participants, in any prescribed burn, be briefed in detail immediately before ignition on such points as ignition locations and sequences, suppression plans, access, escape routes, safety zones, anticipated fire behavior, potential problems, and emergency procedures. Briefings should include the provision of detailed maps and site inspection.

16. A careful analysis of manpower requirements be made for every prescribed burn with the objective of holding on-site numbers of people to a minimum.

17. People assigned to key prescribed burn implementation roles such as Fire Boss, Ignition Boss, Suppression Boss, and the representative of the client program must be intimately involved in the preparation of the plan and familiar with the area at be burned.

18. Qualified alternates for the key implementation roles be assigned to the planning process for each prescribed burn at an early stage.

19. A senior Fire Control person or a qualified Fire Safety Officer be a member of the planning team to fill the safety audit function and take an active part of the prescribed burn.

20. A minimum of Unit Crew training be required for all personnel involved in prescribed burning ignition and suppression, including Junior Rangers and Experience students. This does not exclude untrained staff from being used in support roles.

21. A moratorium be placed on the use of Junior Rangers and Experience students for prescribed burn ignition and suppression operations (until No. 20 is put into effect).

NOTES